



ORBITAL OPERATIONS STUDIES

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Natural Resources Research Institute
in association with the
National Aeronautics and Space Administration

College of Engineering
University of Wyoming
Laramie, Wyoming

ORBITAL OPERATIONS STUDY
Grant No. NsG-658

Fourth Semi-Annual Status Report
November 15, 1965 - May 14, 1966

1. Purposes:

The specific purposes of the work supported by this grant were limited by a shortage of funds during this reporting period largely to:

- A. Initiating the formulation of some illustrative samples of informatic forms of telemetry data from the TIROS, NIMBUS and OSO classes of satellites; and
- B. Refining the experimental "TACOS" Tabular Computing System for:
 - 1. Producing experimental samples of informatic forms of orbital data; and
 - 2. Demonstrating some of the automatic techniques with which informatic forms of data are likely to be produced in future operations.

2. Personnel:

The following personnel were part time participants in this work during this reporting period. The numbers in parenthesis following each name indicates the equivalent number of man months expended by each staff member, or the number of months which graduate research assistants were assigned to this work during this six month reporting period.

Staff

John C. Bellamy, Director, Professor of Civil Engineering (2)
C. N. Rhodine, Associate Professor of Electrical Engineering (3)
Howard F. Guill, Mechanical Technician (5)

Graduate Research Assistants

David Fjeld, Math (6)	Larry Bruce, E.E. (6)
James Stuggart, E.E. (2 1/2)	Russell Chadwick, E.E. (6)
Frank Terry, E.E. (2 1/2)	Johan Dahl, C.E. (2 1/2)

Undergraduate Assistants

Robert O. Lamb, C.E. (Hourly)

3. Publications

The only publication during this period resulting from this work was a brief description of an initial trial sample of "Uadic Numeral Portrayals of TIROS Housekeeping Telemetry Data" contained in a brief letter report to the project officer at Goddard Space Flight Center dated January 24, 1966. Dr. Willis Everett continued to edit and revise his nearly completed paper on "A Study of the Magnetohydrodynamic Behavior of the F Region of the Ionosphere" during this period at his new location at the University of New Mexico.

4. Illustrative Examples of Informatic Forms of Orbital Data

The first samples of actual orbital data were obtained for our use on a trip to Goddard Space Flight Center in November 1965. They consist of standard Arabic digit computer-output tabulations of telemetry data from each of the TIROS, NIMBUS and OSO satellites and include about:

- 450 11"x15" sheets of TIROS housekeeping data;
- 48 11"x15" sheets of NIMBUS housekeeping data;
- 180 11"x15" sheets of OSO-2 housekeeping data; and
- 600 11"x15" sheets of OSO-2 all-channel print-outs.

The intent of obtaining this data was to transcribe (manually with an appropriately modified typewriter) as much of it as proves to be needed to obtain representative samples of its appearance in various experimental "uadic" numeral formats.

An initial trial sample of a "uadic" numeral portrayal of eight channels of Housekeeping Telemetry data from about 250 orbits of TIROS-IX was completed in January 1966. This trial sample is very encouraging; it indicates that very large data-compression factors (of the order of 200 to perhaps 450 to one in comparison with current practice) might well be achieved to provide, among other things, a comparable increase in ease and effectiveness of manual interpretability of "raw" telemetry data of

this kind. Based upon these encouraging initial results, most of the effort of this kind during the remainder of this reporting period was expended on (1) extending the trial samples of TIROS HT data to include more of its 90 channels for the nearly 1100 orbits for which we have the data and (2) extending the use of this "uadic" form of numeral to the kind of telemetry data which is received from NIMBUS.

5. Informatic Data Recorders

The development of experimental recorders for informatic forms of data was restricted by the lack of funds during this reporting period to a continuation of experimental tests of those kinds of mechanisms with which the desired, extremely small, kinds of numerals might best be formed simply and reliably. Several potentially useful techniques were tried and found to be unsuitable in one way or another; two others were being tested at the end of this reporting period.

6. Continuous Data Output Buffers

Research on appropriate devices for processing continuous data during this reporting period consisted of:

- a. Modifying the reflective-optics kind of "tabular converter" and "tapper-bar" recorder which had been donated to us by the Cook Electric Company so that they could be used as part of the "TACOS" experimental Tabular Converting System; and
- b. Constructing the electronic circuitry and adapting a teletype tape reader so that 5-hole punched tape can be utilized as a data-input into "TACOS" for experimental formulations of informatic forms of data in the future.

7. Operational Engineering Research

Although virtually no activities of this kind were funded by this grant during this reporting period, the following closely related activities are worthy of note with respect to the basic purposes of this Orbital Operations Study.

a. Units of Measure

The kind of work reported upon in "Proposed Nautical Units of Length and Time" under this study is being continued largely in association with the Institute of Navigation's Ad Hoc Technical Committee on Operational Units of Length and Time. This work has indicated that the prefix "geo-" might much better be used than the adjective "nautical" to identify these units. It has especially resulted in the discovery of a simple way to define units of mass, force or weight, pressure, etc. for exceptionally convenient use in conjunction with the newly proposed "geo-units" (or any other units) of length and time. The importance of having such a capability (of readily selecting and using those particular units which are characteristically appropriate for the particular purposes at hand) is becoming increasingly clear in our attempts to select the most suitable units of measure for the numerical portrayals of the TIROS, NIMBUS and OSO telemetry data.

b. Standard Atmosphere

The primary motivation responsible for the evolution of the concept of the nautical (or now "geo-") units of length is the desire to establish a uniform set of units for altimetry in both meteorological and aeronautical operations throughout the world. A logical consequence of the (potential) use of such units is that the Standard Atmosphere should also be defined in terms of (round values of) those "geo-units". Toward this end, the definition of such an atmosphere was largely accomplished during this reporting period in a graduate Civil Engineering class, "Principles of Aerodesy." This definition of a Standard Atmosphere is closely related to the purposes of this Orbital Operations Study since it incorporates a newly conceived and apparently quite useful evaluation of "the (aerodynamic) top of the atmosphere."

8. Plans for the Next Period

A greatly increased level of activity is planned (and has been well instituted by the time of writing this report) for the next semi-annual reporting period. In accordance with the understandings reached concerning the intent of the second supplement (of \$80,000 received in June 1966) to this grant, it is to concentrate on whatever solutions informatic forms of data might provide for problems of the several Control Centers in Building 14 of the Goddard Space Flight Center. Toward this end, primary effort during the Summer of 1966 is to be concentrated on the construction of equipments for producing experimental samples of informatic forms of data from a punched-tape form of data input. A relatively minor effort will, at the same time, continue on manually typewriting initial trials of "uadic" numeral tabulations of housekeeping telemetry data. It is expected that this summertime work will provide the facilities and background required to produce a great many demonstrative examples of informatic forms of data throughout the remainder of the May 15, 1966 to May 15, 1967 year covered by the second supplemental monies.